Shadow art

Summary

Age category
9 - 12 years
Topic
Geometry
Measurement
Total duration
195 minutes

Students discover how shadows are formed. They create an artwork with shadows and recyclable materials. They draw a floor plan of their artwork.

Problems to be tackled:

- How can we create a shadow?
  What do we need to obtain a clear shadow?
- How can we make the shadow smaller/bigger?
  Which variables should we change to obtain a bigger/smaller shadow?
- How can we create an artwork (skyline) that matches all criteria?
- How can we draw a three-dimensional setup in two dimensions (floor plan)?

Real context

Real world motivation

The students visit a pop-up museum with artwork made of shadows. They are encouraged to create such an artwork on their own.

Goals

Skills

Domain-general:

- Problem-solving (e.g. generating ideas to create a shadow skyline)
- Planning (e.g. making choices concerning the design of a shadow skyline)
- Predicting (e.g. thinking about the form a shadow based on a setup of objects)
- Collecting, analysing and interpreting data (e.g. investigating the effect of moving an object on the size of the shadow)
- Reporting data (e.g. sketching the setup of objects to form a shadow)
- Adjusting (e.g. making improvements to a shadow skyline based on observations)
- Reflecting (e.g. discussing what should have been done differently)

Mathematics:

- Using various spatial representations (drawing a two-dimensional plan of a three-dimensional setup, building a three-dimensional setup based on a two-dimensional plan)

stem4math

Co-funded by the Erasmus+ Programme of the European Union

- Measuring and drawing length in relation to the concept of scale

Science:

- Investigating scientific phenomena (shadow) with guidance

Knowledge

Mathematics:

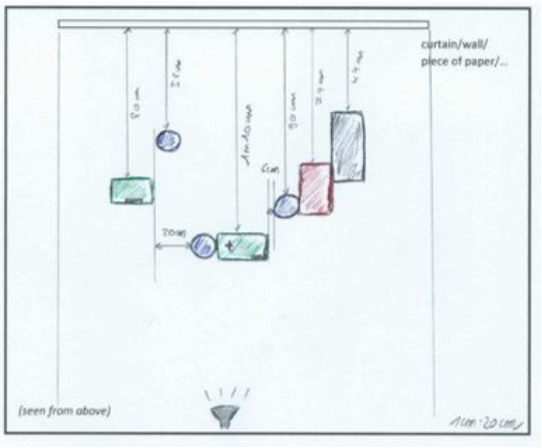
- Scale. Floor plan.
- Spatial orientation. 2D- and 3D-representation.

Science:

- Shadow (e.g. which variables influence the shape and size of a shadow)

Methodology

Part	Description	Timing
1	**Pop-up museum of shadow art: exposition - discussion** The students are invited to look at different pictures that show shadow art. Their findings are discussed in class by asking questions: • What do you see on the pictures? • Which materials did the artist use to create the artwork? • How are the artworks created? • ...	20'
2	**Investigating shadow: group work - discussion** To be able to create such an artwork, the students are first invited to imitate different shadows. They investigate how to form a shadow, how to make a shadow smaller/bigger, ... They sketch their setups from above and from aside. They draw conclusions about forming shadows. The conclusions are discussed in class.	40'

3	**Creating a skyline as piece of art: group work** The students guess how the skyline on the following picture is created. They get the challenge to create their own skyline that meets different criteria (e.g. a slope roof, at least 5 buildings, ...). They work as follows: • they sketch a floor plan • they build their skyline according to their floor plan • they evaluate their skyline in relation to the criteria • they improve their skyline so that it becomes a real piece of art	60'
4	**Drawing a scale floor plan: group work** The students are challenged to be able to rebuild their skyline. They need to draw a floor plan so that they can move their artwork to another place, rebuild their artwork at another time (e.g. during an open day at school), ... They need to be precise, measure and choose a scale, e.g.  	40'

stem4math

Co-funded by the Erasmus+ Programme of the European Union

5	**Exposition of skylines: groupwork** Ideally, the students get the opportunity to set up an exposition consisting of their skylines. Based on their floor plans they rebuild their skylines. They talk to visitors about their art work and the process of creating it.	15'
6	**Reflection: group work - discussion** The students reflect. They think about what they have learnt, and they discuss the process of investigating, creating, ... Their findings are discussed in class.	20'

Organization

Materials

- Pictures of artwork (see printables)
- Per group:
  - 1 torch
  - 5 cans
  - cardboard
  - 1 white sheet of paper (A3) / white wall
  - 1 pencil
  - 1 ruler
  - 1 worksheet (see printables)

Printables

- Examples Shadow art
- Worksheet Shadow art

Grouping

- Groups consist of three students.
- Attitudes needed in a group:
  - Creativity
  - Accuracy

Coaching

Useful questions

- How can you change the size of the shadow?
- How can you change the shape of the shadow?
- Does your skyline meet all the criteria?
- Can you rebuild your skyline based on your plan?
- Which scale will you use to draw the plan?
- General reflection questions, such as:
  - What are you doing? Why?
  - What is the problem?

- What can you do differently?
- What did you do? What went well/wrong? Why?
- What would you do differently next time?
- …

Adaptations

During part 2 of the methodology (investigating shadow) **challenge 2 and 3** in the worksheet can be offered to **fast learners**.

To find out more about the forming of shadows students can also **go outside**.

This is interesting for **young children** as this probably matches their earlier experiences with shadow and they can use their own body to form shadows.

For **older children**, forming shadows with the sun can be more challenging as these shadows have a different shape because of the height of the sun. During different parts of the day they can be challenged with questions such as:

- How can you create a shadow as big as your own body length?
- How can you create a shadow 1,5 times bigger than your own body length?

Depending on the height of the sun, they will have to make themselves bigger or smaller.

The **criteria for the skyline** can be made **more difficult or more easy** (e.g. creating windows, constructing buildings with certain proportions in comparison to each other, …).

With **older students** the creation of the skyline can be made **more challenging**, for example:

- Creating one big skyline by combining the skylines of the different groups
- Creating a city in the middle of the classroom. A different skyline can be created depending on the position of the torch in relation to the city.
- Creating a city in a corner of the classroom:

Artist Rashad Alakbarov

- If students are keen on the creation of shadow art, other options are possible, for example:

Artist Vincent Ball

Assessment

Teacher's assessment:

stem4math

Co-funded by the Erasmus+ Programme of the European Union

Assessment takes place in a formative way, especially regarding:

- Problem-solving (e.g. generating ideas for the skyline)
- Planning (e.g. planning the construction of the skyline)
- Analysing & interpreting data (e.g. explaining which factors influence the size of a shadow)
- Reflecting (e.g. rethinking the process of creating the skyline)
- …

Student's assessment:

- Group work (e.g. based on criteria, such as timing, communication, …)
- Individual contribution (e.g. self- and peer-evaluation)
- Reflection questions:
  - What have you learnt?
  - Did you use mathematics? When? Examples?
  - What did you do very well? Why?
  - If you would start over, what would you do differently?
  - …

Tips & Tricks

- Let the students guess how the skyline is created. Don't show the whole picture of the skyline immediately: hide the setup of recyclable materials.
- Encourage the students to first think about how the skyline should look like based on the criteria before they start constructing (see 'Plan' in worksheet).
- Make sure that the artwork (skyline) can stay in the classroom for a while so that the students can optimize.

stem4math

Co-funded by the Erasmus+ Programme of the European Union